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PATENT SPECIFICATION 1,146,564

DRAWINGS ATTACHED.

1,146,564

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Int. Cl.:– F 28 c 3/12.

COMPLETE SPECIFICATION.

Device for Exchanging Heat or Material Between a Fine-Grained or Powdered Material and a Gaseous Medium.

We, POLYSIUS G.m.b.H., of Graf-Galen-Strasse, 17, Neubeckum/Westphalia, Germany, a German Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a device for exchanging heat or material between a fine grained or powdered solid material and a gas and comprising a shaft in which the gas is swirled upwardly, means for introducing the solid material into a central zone of the gas flow in an upper region of the shaft, a series of conduits located externally of the shaft and each disposed so as to receive solid material carried upwardly and outwardly from a central gas flow zone and to direct this solid material into the central gas flow below the entrance to the next lower conduit.

In a known device of this type, the substantially cylindrically formed shaft interior has an approximately constant cross-section over its entire height. Since there is hardly any gas flow in the material conduits lying outside the shaft interior, the material in these conduits must move down purely under gravity. Such a device involves two serious disadvantages:—

The relatively narrow conduits, wherein material extracted from one shaft section travels down to the next lower section, are relatively easily obstructed with material, especially in the hotter zones of the device, which affects the continuous movement of material through the shaft. When with such a conduit, partly obstructed with material, the weight of the superimposed column of material leads to the material being forced out, mostly coagulated into larger lumps, the weight of the lumps re-entering the shaft interior from such a conduit is frequently too great to allow these particles to be raised somewhat by the gas stream in the shaft interior to the desired manner. Instead these lumps of material are projected from the inlet point to the shaft interior and do not undergo the required heat treatment.

The object of the invention is thus to provide a device of the type described which avoids these disadvantages.

According to the invention this object is achieved in that the shaft is of smaller cross-section at each zone of solid introduction into said gas flow than at zones where the solid enters the conduits.

Such a configuration of the shaft interior spaces improves conditions in two respects.

Because of the varying cross-section dimensions there is a relatively high gas speed in the zones of solid introduction, which ensures intensive engagement of all material re-entering the shaft interior at the zones concerned, thus preventing "pancaking" of the larger particles of material.

The cross-sectional variation provided by the invention also ensures that a somewhat higher pressure prevails in the shaft interior adjacent the zones where the solid enters the conduits than adjacent the zones of solid introduction to which the conduits lead. This pressure difference produces an auxiliary gas flow in the individual conduits in the direction of material movement, which effectively prevents clogging of these conduits by the material.

Both effects, i.e. the high gas speed adjacent the zones where the solid enters the conduits, and the auxiliary gas flow in the conduits, thus contribute to the entire material travelling continuously through the shaft interior, without disruptive clogging effects and with uniform treatment of all

particles, so providing optimum exchange of heat or material between the material and the gaseous medium.

In a preferred embodiment of the invention the conduits provided utside the shaft interior enter the shaft interior tangentially downwards at the zones of solid introduction. This means that on re-entering the shaft interior, the auxiliary gas stream present in these conduits effectively aids the upwardly swirling main gas stream there present.

One embodiment of the invention is shown in the drawings. In these:—

Figure 1 is a longitudinal section through a diagrammatically represented device of the invention,

Figures 2 and 3 are cross-sections on lines II—II and III—III of figure 1,

Figure 4 is a diagrammatic representation for explaining the speed and pressure conditions prevailing in the shaft interior.

The device provided by the invention as shown in figures 1—3 comprises as main element a shaft 1 composed of several similar shaft sections (e.g. 2, 2^1.). Each such shaft section comprises in general a material inlet zone 3 of relatively narrow cross-section, a material outlet zone 4 of considerably larger cross-section and two conical transition zones 5, 6.

Outside the shaft interior are provided conduits 7, each connecting the outlet zone 4 of one shaft section (e.g. 2^1) with the inlet zone 3 of the shaft section (e.g. 2) lying below. Proceeding e.g. from outlet zone 4 in shaft section 2^1, the corresponding inlet zone 3 lies below the outlet zone 4 (of shaft section 2) lying next below the considered outlet zone 4 (of shaft section 2^1).

Conduits 7 open generally tangentially into the shaft interior in the inlet zones 3. To simplify the drawing only one conduit 7 has been shown for each shaft section: instead however several conduits may be provided, distributed around the shaft periphery.

In its lower section the shaft 1 is provided with a gas inlet 8 entering the shaft interior tangentially and with a funnel-shaped material outlet 9. To the upper end of shaft 1 is connected a cyclone 10 and a blower 11. A charging valve 12 is provided for the material inlet.

The device of the invention operates as follows:—

The gas, used for example to pre-heat the fine-grained or powdered material, flows tangentially through inlet 8 into the shaft interior and moves up helically in the shaft (corresponding to the solidly drawn path 13). Because of the variations in shaft interior cross-section up the shaft height, the gas flow rate c varies in the manner shown in the right half of figure 4: adjacent the narrow material inlet zones 3 a high gas speed prevails, while the outlet zones (of relatively wide cross-section) are flowed through considerably more slowly.

Pressure conditions in the shaft interior vary in accordance with this speed distribution, as shown in the left half of figure 4: a considerably more marked pressure drop ($-p$) prevails in the area of inlet zones 3 than in the superimposed outlet zones. Between the top and bottom ends of individual conduits 7 there is thus a pressure drop Δp, causing an auxiliary gas flow in these conduits from top to bottom (i.e. against the main direction of gas flow in the shaft interior).

Material fed through charging valve 12 into the shaft interior is first carried by gas into the cyclone 10, is there separated and passes through cyclone exit pipe 10a into the top shaft section. Here material fed into the central part of the gas stream is taken upwards somewhat by the gas, is forced to the shaft perimeter by the centrifugal effect of the helical gas flow, then leaves the shaft interior in the vicinity of zone 4 of the top shaft section, travels down through the top conduit 7 and re-enters the shaft interior in the vicinity of zone 3 of the next shaft section 2^1 down, where the process described is repeated. In this way material travels in stages from the top down through the shaft, and during its stay in the shaft interior is in intensive heat exchange with the gas.

The downwardly directed auxiliary gas flow prevailing in conduits 7 ensures completely reliable and non-clogging transport of material to the next lower shaft section, where immediately on re-entering the interior the material is entrained by the high-speed gas present in inlet zone 3 and is again carried a distance upwards. The movement of material is indicated in the drawing by dotted lines 14.

WHAT WE CLAIM IS:—

1. A device for exchanging heat or material between a fine grained or powdered solid material and a gas and comprising a shaft in which the gas is swirled upwardly, means for introducing the solid material into a central zone of the gas flow in an upper region of the shaft, a series of conduits located externally of the shaft and each disposed so as to receive solid material carried upwardly and outwardly from a central gas flow zone and to direct this solid material into the central gas flow below the entrance to the next lower conduit, the shaft being of smaller cross-section at each zone of solid introduction into said gas flow than at zones where the solid enters the conduits.

2. A device according to Claim 1 wherein alternate conduits are disposed at opposite sides of said shaft, the outlet of each inter-

mediate conduit being disposed below the entrance to the next lower conduit.

3. A device according to Claim 1 or Claim 2 wherein the lower ends of the conduits enter the shaft tangentially downwards at the zones of solid introduction.

4. A device according to any preceding Claim wherein the shaft interior widens conically from each zone of solid introduction to the next higher conduit inlet.

5. A device for exchanging heat or material between a fine grained or powdered material and a gas substantially as herein described with reference to the accompanying drawings.

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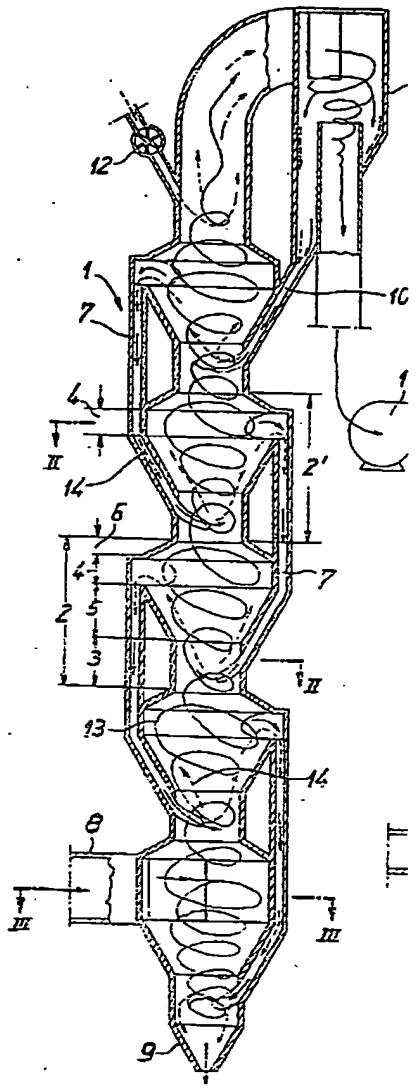

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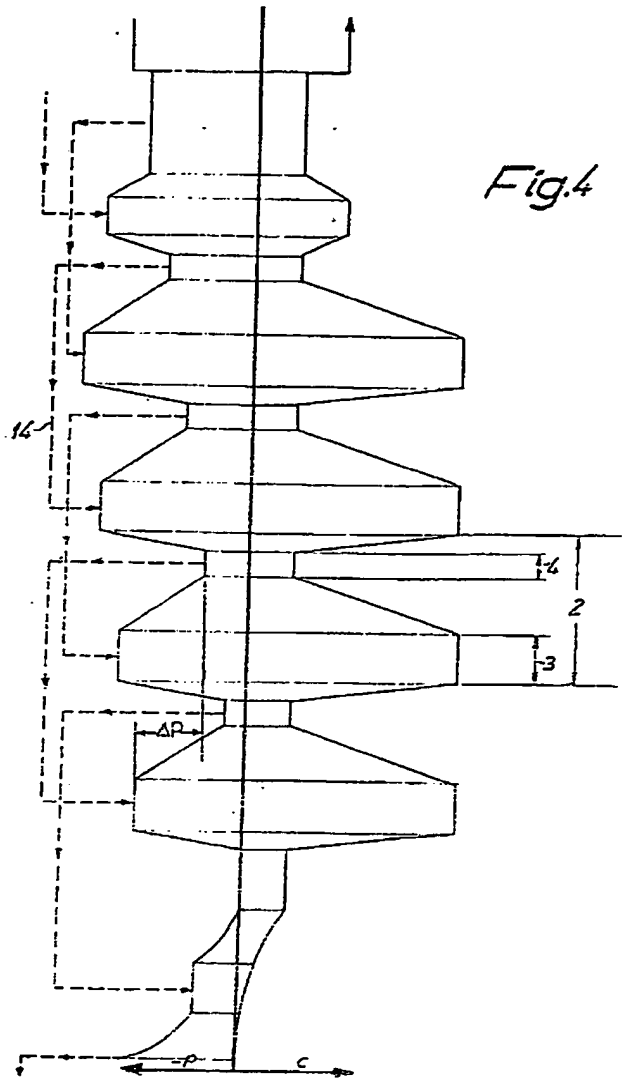

Fig.4

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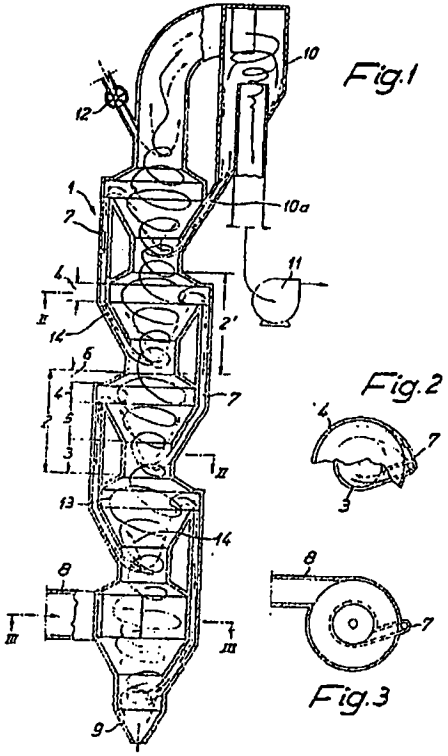

Fig.1

Fig.2

Fig.3

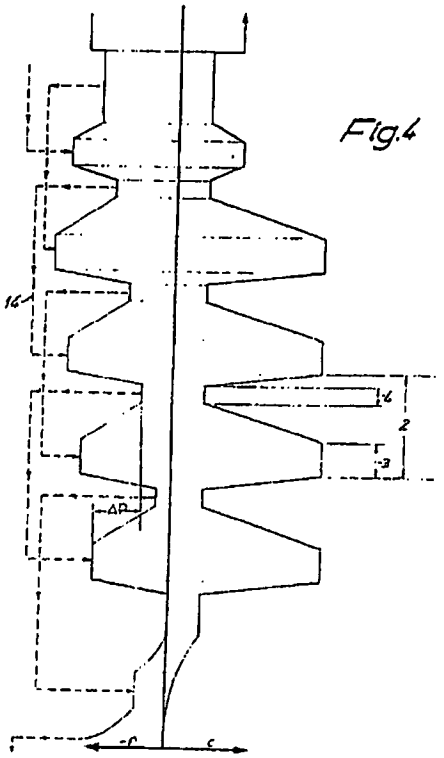

Fig.4